**Remarks:**

**R13** Applicant thanks the Examiner for the Examiner's attention to the application.

**R14** Claims 1 to 29 were pending in the application..

**R15** Claims 1 to 29 stand rejected.

**R16** Applicant notes the entry of the previous amendments to the specification.

**R17** Applicant notes that previous arguments with respect to the previous 35 U.S.C. §103(a) rejection have been persuasive.

**R18** Applicant notes mention in the Application Papers section of the Office Action Summary of acceptance of the drawings. The statement refers to drawings filed "12 May 2008", however drawings have been submitted 12 May 2005. Applicant proceeds under the assumption that the drawings have been accepted.

**R19** Applicant has identified printing errors in paragraph [0050] of the published application. The underlying code for printing appears to be correct in that ".quadrature." should print a capital Greek character Pi "Π", however the character is not printing. Applicant proposes using the expression "pi" as shown in the amended code.

**R20** Claim 1 has been amended, without prejudice, to comply with the Examiner's requisition to amend stated at point 5 of the outstanding Office Action. The amended claim 1 now clarifies that the method is performed in a receiver. Support for the amendment is provided in independent claim 15.

**R21** Claims 5, 10, 11, 23, 24 and 26 have been canceled.

**R22** Claims 1 to 4, 6 to 9, 12 to 22, 25 and 27 to 29 are now pending in the application.

**R23** It is submitted that no additional subject matter has been introduced by the amendment.

**Arguments:**

Statutory subject matter rejection:

**A11** Claims 1 to 14 have been rejected under 35 U.S.C. §101 for failure to meet the machine or transformation test under *In re Bilski*.

Amended claim 1 now reads "In a receiver, a method of improving sensitivity in the demodulation of a received signal ...". The method of claim 1, as amended is now tied to a statutory receiver apparatus.

Applicant respectfully requests retraction of the 35 U.S.C. §101 rejection in respect of claims 1 to 14.

Prior art characterization:

**A12** In support of arguments for the patentability of the amended claims presented hereinbelow, applicant respectfully submits the following characterization of the Van Stralen cited prior art:

By way of a summary, the objective described in Van Stralen is to demodulate deliberate phase modulations expressly introduced in the signal by a remote transmitter data modulation process. A Viterbi style maximum likelihood phase estimation is used to extract the modulated signal. Discrete output phase states are selected corresponding to the phase modulation applied at the transmitter. Van Stralen stresses as a condition for success in demodulating data, a "high SNR" is required for decoding the carrier phase transitions. The forgoing summary is supported by the following detailed analysis:

Van Stralen (column 4 lines 28 to 30) is concerned with demodulating a "... modulated received signal y(t), which is equal to the transmitted signal s(t) plus channel noise ..." wherein (column 4 lines 14 to 19) a "receiver is operated in a tracking mode, ... [wherein] the signal-to-noise ratio (SNR) is high enough so that the detected data sequence is usually correct ..." Van Stralen clearly states (column 4 lines 19 to 22): "The invention is based upon the understanding that, with these assumptions [receiver operated in tracking mode and SNR is high enough], the right side of equation (7) can be used as an error signal to correct the current estimate of the carrier phase reference."

As in Huff, in order for the apparatus described by Van Stralen to operate as intended (column 4 lines 54 to 61), namely: "... to form an estimate of the transmitted data sequence ...", "... CPM detector block 314 receives signal y(t) and estimates of the transmitter phase reference $\theta$ and the transmitter timing reference $\tau$, and uses these inputs, together with the Viterbi algorithm ... ". Van Stralen describes the use of phase shifted 326/512 branch metrics or the use of a quadrature component (column 5 line 27) at each symbol interval (column 2 lines 44 to 47, column 7 lines 4 to 7, and column 7 lines 26 to 29) to select a branch having a highest probability. Like in Huff, the trellis used by Van Stralen is comparatively large particularly when both the un-shifted and shifted components are tracked.

In Van Stralen, as in the other cited references, the trellis and the Viterbi algorithm are applied to a specific modulation technique characterized by a signal phase which moves between a set of discrete phases employed in the modulation. In Van Stralen this is confirmed by the use of the symbol timing reference both as an input and as a trigger for computation in a receiver operating in tracking mode.

Applicant respectfully submits that the description Van Stralen is cumulative to the description in Huff.

Differences between the prior art and the claimed invention:

**A13** Applicant respectfully submits that the subject matter of the claims relates to improving the sensitivity of demodulation of a received signal as separate from demodulating a received signal. The sensitivity is affected by random phase instabilities which are due to unknown doppler components of a GPS signal and phase instability of a receiver clock which are modeled by a statistical model. The phase states in the current invention are selected to provide an approximate discretized representation of a continuously varying random phase. Problem addressed in the present application is different than the problems addressed in the prior art, namely the present application is directed to tracking of a low SNR GPS signal. Specifically:

(i) In contrast with Van Stralen, which assumes high enough SNR so that the detected data sequence is usually correct (column 4 lines 14 to 19), the claimed invention addresses adverse reception conditions described at paragraph [0003] of the published application, wherein the "input raw GPS, prior to processing, is more than 40 dB below the thermal noise floor." Employing a symbol timing reference teaches away from the claimed invention.

(ii) In contrast with all cited references, including Van Stralen, the claimed received signal processing is approached in a novel way namely, the received signal experiencing a phase excursion is considered from the point of view of a continuous free-running oscillator, the phase variations of which are continuous in time. Relevant causes of the phase excursions include, but are not limited to: local

oscillator instability, offset and drift, as well Doppler effects of the received signal itself (page 2 first paragraph, page 3 first paragraph, etc. of the U.S. National Phase entry application). Such a free-running oscillator includes as physical examples the low-quality, low-cost local oscillator, the Doppler shifted high-quality GPS SV signal, and the received CDMA pilot signal distorted due to the mobile handset being in motion. Van Stralen does not address signal phase excursions continuous in time.

(iii) In contrast with Van Stralen (and the other cited prior art) which employs a large trellis for both the un-shifted and shifted components and large computational resources to estimate the transmitted data sequence, the claimed invention is directed to minimizing resources necessary to characterize the phase excursion. The MatLab simulation presented in the description, identifies the minimum size trellis necessary for modeling and tracking a continuous free-running oscillator phase excursion while using a minimum number of phase measurements and least computational resources (see first paragraph on page 8 of the National Phase entry application). Also in contrast with Van Stralen, the claimed invention employs a Markov process to model the continuous phase excursion which allows employing the least number of intervals to minimize the number of phase measurements, the size of the trellis, and thus minimize the processing overhead.

Put another way, the cited prior art references are cumulative describing only extracting an estimate of the transmitted data sequence, whereas the claimed invention is directed to determining the phase trajectory of an input signal.

Applicant respectfully requests retraction of the 35 U.S.C. §103(a) rejection because the cited prior art is cumulative and teaches away from the claimed invention.

With respect to the claims:

**A14** In response to the Examiner's rejection of independent claims 1, 15, and 29 rejected under 35 U.S.C. §103(a), Applicant respectfully submits that the cited references do not describe every claimed element and step:

(i) With respect to the claimed "performing a maximum likelihood estimation of a phase trajectory of the input signal", the excerpt pointed out in the articulated arguments is insufficient because at column 5 lines 38 to 47 and column 7 lines 29 to 33 of Van Stralen describes something entirely different namely the quadrature/phase shifted component of the branch metrics.

(ii) The claims are directed to "defining possible state transitions from and to each phase state node". Huff describes something entirely different, namely a limitation to "allowed transitions" which restrict the trellis to characterize the expected modulated signal only. Support for this assertion is found in Huff lines 60 to 64 of column 5 and particularly lines 24 to 27 which read "This invention applies whenever the parameter value(s) associated with a state in a root trellis diagram explicitly or implicitly includes a value for the modulation phase of the transmitted signal". Applicant respectfully submits that in accordance with the claimed invention, in order to track the phase trajectory of the free running clock all transitions need to be considered, though some transitions may be highly improbable as described at lines 3 to10 on page 6 of the National Phase entry application. Argument A7 presented in applicant's prior submission stands.

(iii) The claims relate to a "measured phase of the correlation signal having a random process approximated utilizing a discrete Markov process" and therefore the claims distinguish over Pekarich which describes "a received signal having a random process approximated utilizing Markov process" as articulated in the second paragraph on page 13 of the outstanding Office Action. Because, as articulated in the outstanding Office Action, it is "the received sequence [which] is a finite-state, discrete time Markov process", Pekarich teaches away from the claimed correlation signal. Argument A8 presented in applicant's prior submission stands.

(iv) The claims relate to "assigning a transition probability to each path" and therefore distinguish over Czaja which at column 7 lines 16 to 33 describes something entirely different, namely path memories.

(v) The claims relate to "creating a likelihood metric for each path based on a measured phase of the correlation signal and the transition probability for the path" and therefore distinguish over Czaja which at column 8 lines 1 to 16 describes something entirely different, namely path elimination.

(vi) The claims relate to "utilizing a Viterbi algorithm on said trellis to perform a maximum likelihood estimation of a phase trajectory of the correlation signal with said quantized resolution of phase states over 0 to 360° throughout the measurement time epoch". Applicant respectfully submits that objective evidence of prior art teaching of the claimed step has not been provided because the passage in column 13 lines 29 to 34 cited to allegedly teach the impugned functionality, in actual fact concerns a "no-migration composite trellis" as stated in same paragraph. Also,

multiplication by 2pi/32 is not maximum likelihood estimation utilizing a Viterbi algorithm.

Therefore, for the above reasons applicant respectfully submits that a *prima facie* case of obviousness has not been established in respect of independent claims 1, 15 and 29 by failure to produce prior art teaching of each and every step/element claimed.

**A15** Dependent claims 2 to 7, and 16 to 28 variously depend directly and/or indirectly respectively from independent claims 1 and 15 and therefore incorporate all respective limitations of independent claims 1 and 15. Therefore, applicant respectfully submits that a *prima facie* case of obviousness has not been established in respect of dependent claims 2 to 7, and 16 to 28 by failure of produce prior art teaching of each and every claimed element and step thereof.

**A16** In *In re Oetiker*, 977, F.2d 1443, 24 USPQ2d 1443 (Fed. Cir. 1992), the Federal Circuit stated that "[i]f the examination at the initial stage does not produce a *prima facie* case of unpatentability, then without more the applicant is entitled to grant of the patent."

Applicant respectfully submits that the above arguments raise questions regarding the establishment of a *prima facie* case of unpatentability.

Reconsideration and allowance are respectfully requested.

Respectfully submitted,

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